

# Cerenkov performance limits due to phototube – base combination

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May 13, 2014

# Phototube – Base

- We use an ET 9215B 8-stage phototube and an ET “fully transistorized” base (voltage divider).
- ET reprint says, “photomultipliers should not be operated for any length of time at anode currents in excess of  $100\ \mu\text{A}$ ...”
- QIE least count  $\approx 3.2\ \text{fC}$ . Operating at  $53.1\ \text{MHz}$ , this is  $3.2\text{fC}/18.8\text{ns} = 0.17\ \mu\text{A}$ .  
→  $100\ \mu\text{A} \approx 600\ \text{QIE units}$ .

# Average current at 5E12

- During 4 – turn injection run recently, G2SEM was  $\sim 5.2\text{E}12$  protons per pulse.
- With phototube HV = 870V, QIEsum was  $\sim 1.2\text{E}11/\text{spill}$  (after subtracting pedestal of  $\sim .07\text{E}11$ )
- Ave QIE value  $\sim 1.2\text{E}11/207\text{E}6 = 580$ .
- Close to, but under the recommended maximum current.

# Pulse performance – deviation from linearity (10 $\mu$ s pulse)

- 700V curve deviates at  $\sim 2.5$  mA.
- 700V curve is 5% low at 10 mA.
- 900V curve deviates at slightly higher current.
- 900V curve is 5% low at  $\sim 15$ mA.
- 900V curve is 10% low at  $\sim 20$ mA.

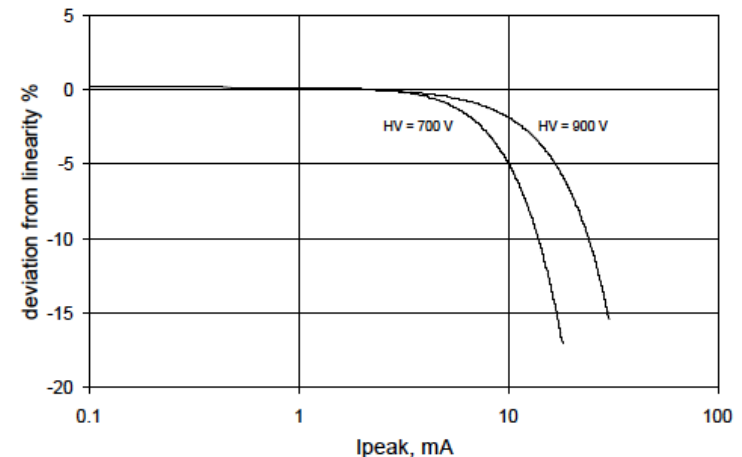


figure 5 linearity performance for pulses of width 1  $\mu$ s. The deviation from linear amplification is a limitation of the pmt, and not to the divider.

# Comparison to our data

- 700V curve deviates at ~2.5 mA.
- 700V curve is 5% low at 10 mA.
- 900V curve deviates at slightly higher current.
- 900V curve is 5% low at ~15mA.
- 900V curve is 10% low at ~20mA.
- 2.5 mA = 14700 QIE
- 15 mA = 88000 QIE
- 20 mA = 118000 (just above high end of range)
- Maximum observed during recent high intensity run ~ 60,000 – 80,000.

# What does it mean?

- The current running condition is not too bad.
- QIESum/G2SEM ratio implies  $\sim 2\%$  sag at  $5E12$ .
- Don't know whether loss comes in:
  - Single buckets (18.8ns time scale)
  - Few high buckets
  - Single Booster batch (1.5  $\mu$ s)
  - Single turn (11  $\mu$ s)
  - Multiple turns